

Prepared by the North American Ice Service

**A collaboration of the Canadian Ice Service and
the National/Naval Ice Center**

3 December 2004

**Seasonal Outlook
Great Lakes
Winter 2004-2005**



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Great Lakes

WINTER 2004-2005

Introduction

This outlook of the expected pattern, timing, and the extent of ice growth attempts to identify areas and periods where conditions should be more or less favourable than normal. It has been developed through an analysis of the oceanographic and meteorological parameters for the summer and the fall proceeding the ice season. These conditions are compared with earlier years, the December wind and temperature forecasts plus the seasonal temperature outlook. A prediction of the ice regime is then produced. **It should be noted that significant variations of these conditions will have an impact on the timing and extent of ice formation.**

Throughout the winter, this outlook will be updated by a twice monthly issue of 30-day forecasts. These forecasts will also indicate the beginning of the spring break-up process throughout the area. Daily radio broadcasts of ice charts and forecasts will be made to support ongoing operations in the various areas where ice affects marine activity. For more information regarding the broadcast schedule, please consult the following Canadian Coast Guard web site (Appendix B - General information from the Canadian Coast Guard). http://www.ccg-gcc.gc.ca/mcts-sctm/docs/ramn_armm/Atl/dls/part5_e.pdf.

General Seasonal Outlook

During the period from the beginning of June to the end of October, air temperatures over the Great Lakes were near to below normal during the month of June, July and August. However for September and October, temperatures were above normal.

The mean 1000 mb pressure chart for November 2004 is shown in Figure 1. The chart indicates a high pressure centre located over the Carolinas with a ridge extending westward. A low pressure centre located over southern Davis Strait combined with the high in the Carolinas generated a westerly circulation over the Great Lakes. Temperatures were above normal over the entire area for the month of November. Departure from normal temperatures for November over the Great Lakes ranged from plus 1.0°C at Rochester to 3.1°C at Duluth.

Figure 2 shows sea surface temperature anomalies over the Great Lakes on November 24th. Generally speaking, water temperatures were above normal over the entire Great Lakes with the exception of eastern Lake Ontario where water temperatures were closer to normal. The figure shows water temperatures ranging from 0.3°C above normal over eastern Lake Ontario to 1.8°C above normal over southern Lake Michigan.

At the end of November, generally ice free conditions prevailed over most of the Great Lakes except in north-western Lake Superior where some new and thin lake ice has formed.

The forecast for December is for near to below normal air temperatures for the Great Lakes region. Freeze-up over the Great Lakes will occur slightly earlier than normal.

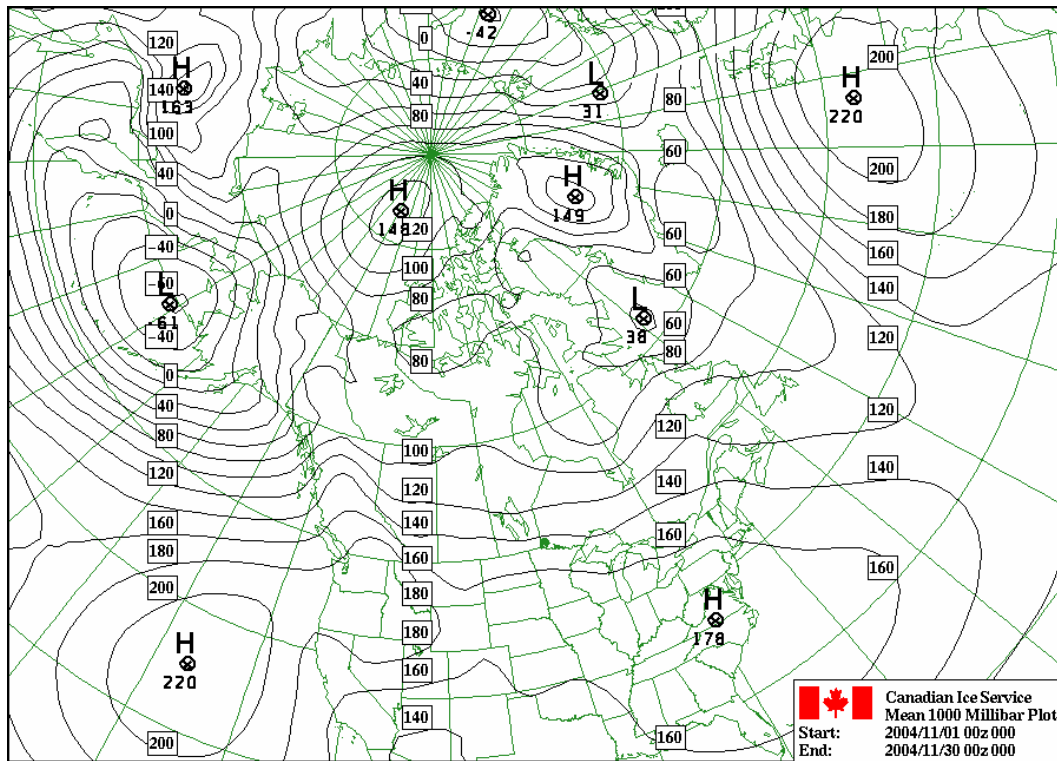


Figure 1: 1000 mb pressure pattern - November 2004

	Normal Temperatures	Observed	Departure
Duluth	-2.2	0.9	3.1
Thunder Bay	-2.8	-0.4	2.4
Gore Bay	1.7	3.7	2.0
Sault Ste Marie	0.6	3.0	2.4
Chicago	4.5	6.7	2.2
Warton	2.7	3.7	1.0
Windsor	4.7	6.3	1.6
Buffalo	4.7	5.7	1.0
Toronto	3.2	5.4	2.2
Trenton	2.6	3.8	1.2
Average	2.0	3.9	1.9

Table 1: Departure from Normal Temperatures - November 2004

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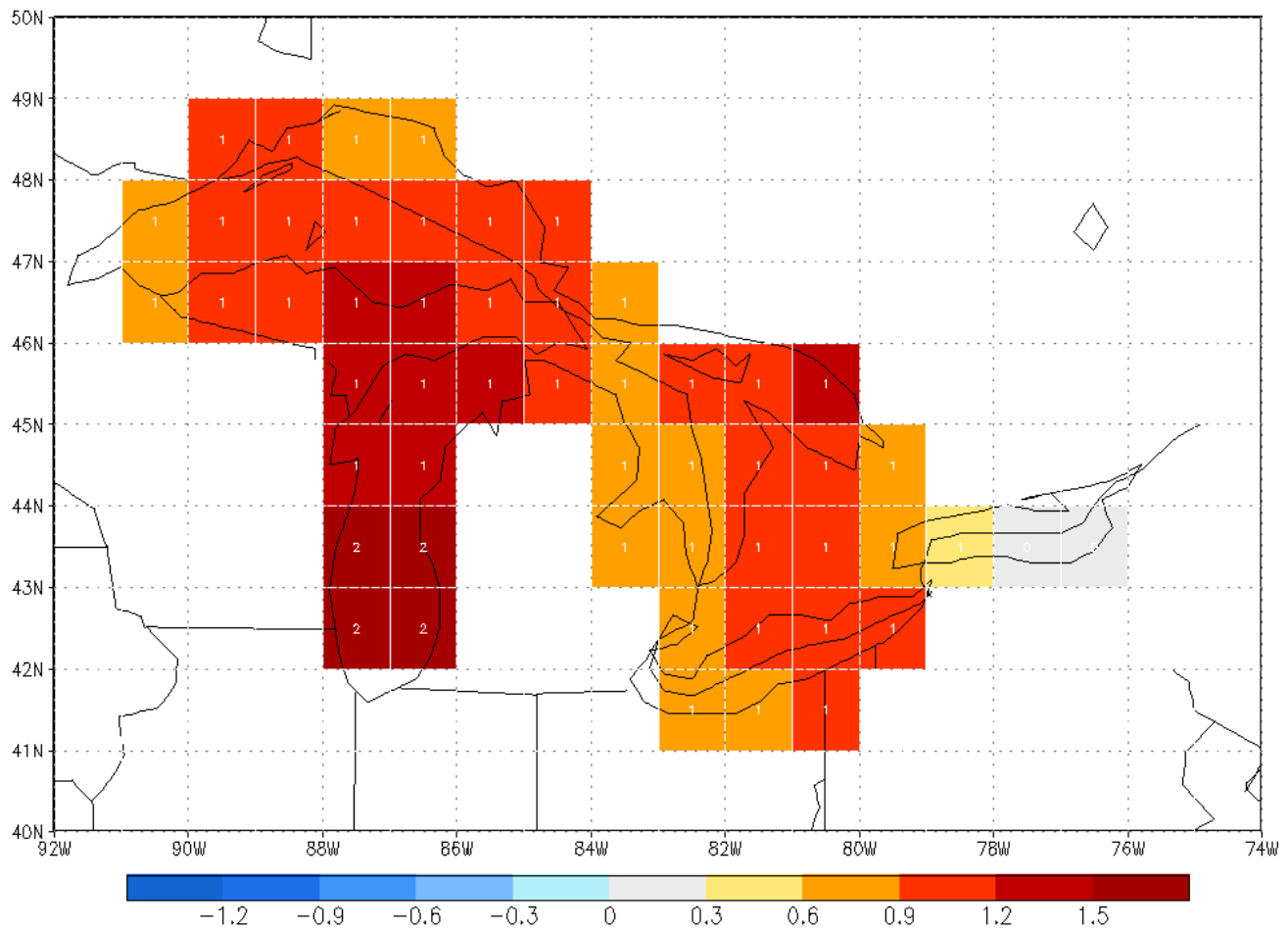


Figure 2: Sea surface temperature anomalies - 24 November 2004 (NCEP)

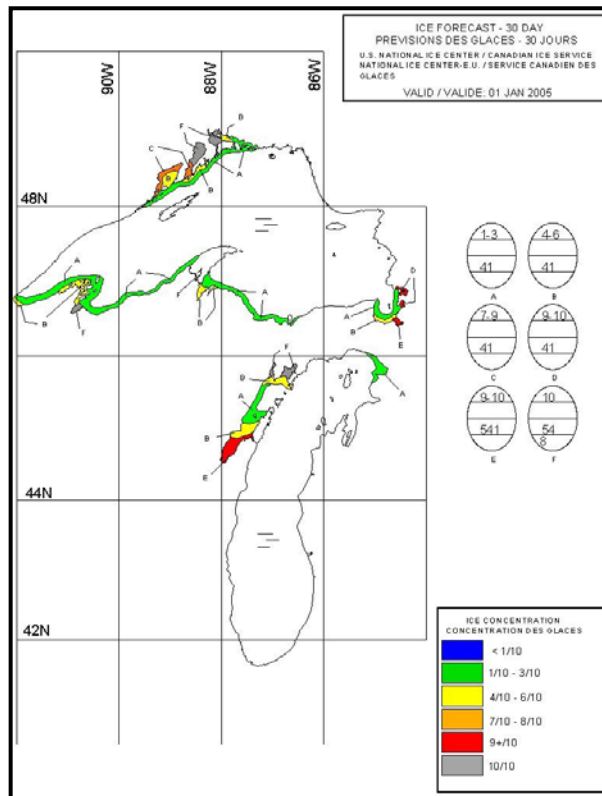


Figure 3: Expected ice Conditions - Western Great Lakes - 1 January 2005

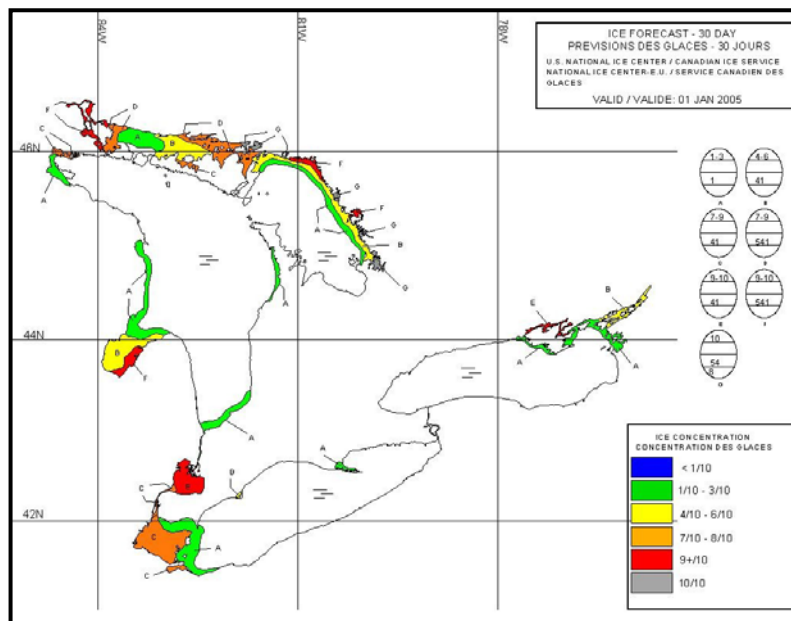


Figure 4: Expected ice Conditions - Eastern Great Lakes - 1 January 2005

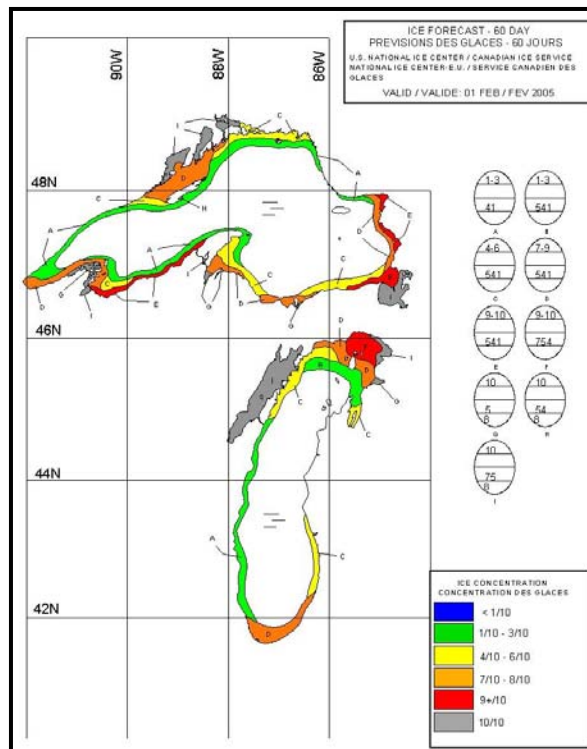


Figure 5: Expected ice Conditions - Western Great Lakes - 1 February 2005

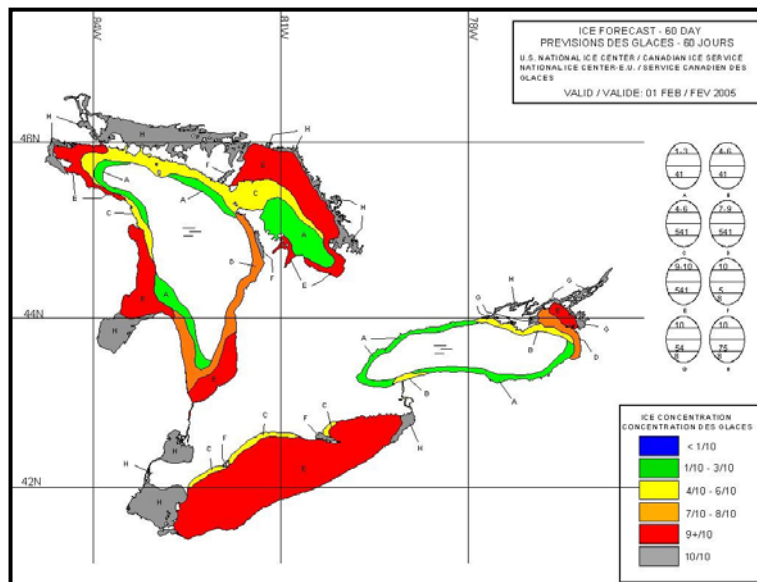


Figure 6: Expected ice Conditions - Eastern Great Lakes - 1 February 2005

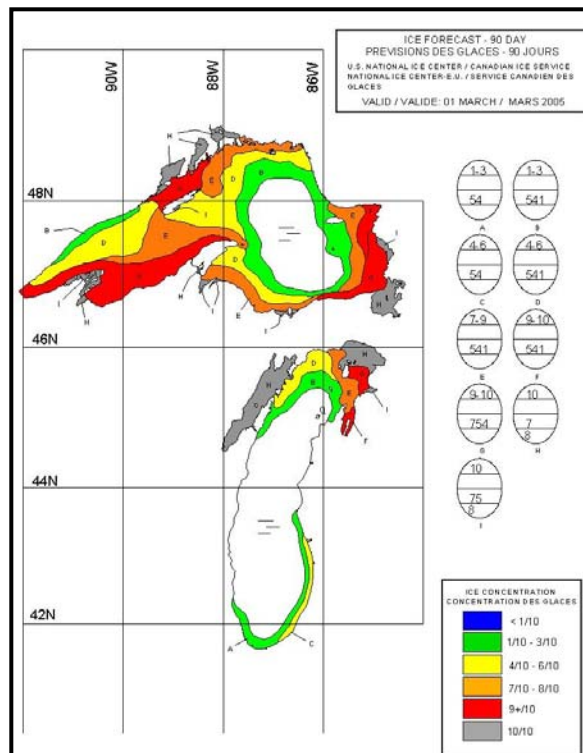


Figure 7: Expected ice Conditions - Western Great Lakes - 1 March 2005

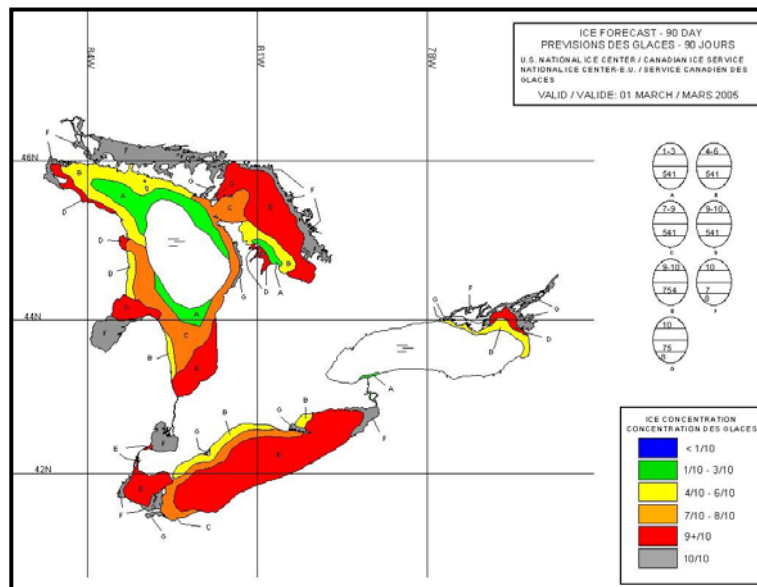


Figure 8: Expected ice Conditions - Eastern Great Lakes - 1 March 2005

Lake Superior

Water temperatures ranged from 0.6°C to 1.5°C above normal over the lake. Air temperatures will average below normal over the entire lake during the month of December.

At the beginning of December, generally open water to ice free conditions will prevail over most of the lake. Some new and thin lake ice will be in Black and northern Nipigon Bays during the first week of December. By the middle of December, some new lake ice will begin to form in north-eastern Thunder Bay. The remainder of the lake will be ice free except for open water within 1 to 4 miles of the coast or ice edge. During the third week, new and thin lake ice will cover most of the St Mary's River while the ice in Black and Nipigon Bays will thicken to thin and medium lake ice. The fourth week of December will see some new ice begin to form around the Apostle Islands as well as near the Duluth area. By the end of December, ice will cover most of Thunder Bay while some ice will begin to consolidate around the Apostle Islands as well as the shallow bays of Whitefish Bay. Some areas of new ice will begin to form along the southern shore of the lake. The remainder of the lake will be ice free except for an area of open water within 2 to 7 miles of the coast or ice edge. At the end of December, the forecast ice extent will be near to great than normal. The expected ice cover for January 1st is illustrated in Figure 3.

The seasonal temperature outlook for January and February indicates that temperatures will be near to below normal over Lake Superior. Hence, ice growth will be somewhat faster than normal. New ice will continue to form especially along the southern portion of the lake and in Whitefish Bay. By mid-January all of Black and Nipigon Bays will be covered with consolidated thick lake ice. Most of Thunder Bay will have thin and medium consolidated lake ice with the central part of the bay remaining mobile. The north-western portion of the lake from Grand Marais to the entrance to Nipigon Bay and within 4 to 12 miles of the shore will have thin and new lake ice. Ice will reach the northern Ile Royale coast. Whitefish Bay will be covered with thin and medium lake ice while most of the St Mary's River will be consolidated with medium and thick lake ice. By the end of the month, Thunder Bay, Black and Nipigon Bays will be completely consolidated with medium and thick lake ice. The southern and eastern portion of the lake near the shore will have thin and new with some medium lake ice. Consolidated ice will cover most of Whitefish Bay with medium and thick lake ice. The remainder of the lake will be ice free except within 3 to 10 miles of the shore and ice edge. The expected ice cover for February 1st is illustrated in Figure 5.

The ice extent will continue to increase during the first half of February. By mid-February, most of the western half of Lake Superior will be covered with thin and medium lake ice. The area near Duluth will be consolidated with medium lake ice while the Apostle Islands will be encased in medium and thick lake ice. Within 20 to 30 miles of the shore in the eastern portion of the lake, ice will be mostly medium with some thick lake ice. Most of Whitefish Bay will be consolidated with medium and thick lake ice. The central portion of eastern Lake Superior will be open water with a few strips of medium lake ice. At the end of February, most of the lake will be covered with ice except for the central portion of eastern Lake Superior where mostly open water will prevail. The ice thickness will vary from thin and medium lake ice in the northern portion of the lake to medium and thick lake ice in the south. The area along the

southern shore will have mostly thick lake ice occasionally under pressure. The expected ice cover for March 1st is illustrated in Figure 7.

With generally below normal temperatures over the winter season and near normal temperatures in the spring, clearing of Lake Superior will occur slightly later than normal.

Lake Michigan

Water temperatures over Lake Michigan were about 1.2°C to 1.8°C above normal over the entire lake.

At the end of November, no significant ice had begun to form. The temperature for the month of December will be slightly below normal over the entire region. At mid-December, there will still not be any significant ice growth except in the northern reaches of Little and Big Bay de Noc as well as the extreme southern portion of Green Bay where some patches of new lake ice could develop. By the end of December, the Little and Big Bay de Noc will be covered with consolidated thin and new lake ice with some medium lake ice. The southern portion of Green Bay will be covered with thin and new lake ice. Some patches of new and thin lake ice will form along the northern shore just west of the Straits of Mackinaw. Elsewhere, ice free conditions will prevail except open water near the shore and ice edge in the northern portion of the lake. The expected ice cover for January 1st is illustrated in Figure 3.

The seasonal temperature forecast indicates generally below normal temperatures for the month of January and February. By the end of the first week of January all of Green Bay will be covered with medium and thin lake ice with some thick lake ice. At the same time, the southern portion of Green Bay as well as the Little and Big Bay de Noc will be consolidated with thick and medium lake ice. Within 1 to 4 miles of the western shore of Lake Michigan some new and thin lake ice will form. The south-western shore of Lake Michigan will have patchy areas of new lake ice. The north-eastern portion of the lake northeast of Beaver Island will be covered with thin and medium lake ice. The central portion of the lake will be ice free with some open water within 5 to 8 miles of the shore and ice edge. By mid-month, the areas of consolidated ice in Green Bay will increase while the bands of ice along the western and south-eastern shore will widen somewhat between 2 to 5 miles from the shore. Some areas of consolidated ice will form just west of the Straits of Mackinaw while the area northeast of Beaver Island will be covered with thin and medium lake ice. By the end of the month, most of Green Bay will be consolidated with thick lake ice. The area within 5 to 10 miles of the western and south-eastern portion of Lake Michigan will be covered with thin and new lake ice with some medium lake ice mostly in the north-western section. Along the north-eastern shore of the lake, some patches of new and thin lake ice will be present while Grand Traverse Bay will be covered with thin and medium lake ice. The north-eastern portion of Lake Michigan from just south of Beaver Island north-eastward will be frozen over with medium and thick lake ice with consolidated ice in the approaches to the Straits of Mackinaw. The remainder of the lake will be ice free to open water. The expected ice cover for February 1st is illustrated in Figure 5.

For the first half of February the ice edge will continue to expand however at a slower rate. By mid-February, most of Green Bay will be consolidated with thick lake ice except for the

north-eastern entrance where the ice will remain mobile. The ice edge along the western and south-eastern shore will be located 8 to 15 miles from the shore and be comprised of mostly medium and thin lake ice. The north-eastern part of the lake will be covered with thin and medium lake ice located within 3 to 8 miles of the shore while Grand Traverse Bay will be frozen over with medium and thin lake ice. The north-eastern portion of Lake Michigan will be covered with thin and medium lake ice from about 10 to 15 miles southwest of Beaver Island north-eastward. Consolidated medium and thick lake ice will extent from Beaver Island to the Straits of Mackinaw. By the end of the month, little change in terms of ice extent will be observed. The expected ice cover for March 1st is illustrated in Figure 7.

With generally near to below normal temperatures during the winter season and near normal temperatures during the spring, ice melt will be slightly slower than normal.

Lake Huron and Georgian Bay

Water temperatures ranged from 0.3°C above normal over the southern part of the lake to 1.2°C in Georgian Bay and the Straits of Mackinaw. Air temperatures will average below normal over the entire lake during the month of December.

At the beginning of December, mostly ice free conditions will prevail over Lake Huron and Georgian Bay. During the second week of December, some new and thin lake ice will begin to form in the shallow bays of the North Channel and Georgian Bay. Saginaw Bay will also have new and thin lake ice along the shore during the same period. By the end of the month, most of the North Channel will be covered with thin and medium lake ice with a small area of open water in the southern section of the channel. The shore adjacent to the Straits of Mackinaw will have some new and thin lake ice forming. Patches of new and thin lake ice will begin to form along the western shore of the lake from Thunder Bay southward to Saginaw Bay. The ice in Saginaw Bay will thicken to medium lake ice. Some patches of new and thin lake ice will form along the eastern shore of Lake Huron. As for Georgian Bay, the entire north-eastern shore will be frozen over with thin and medium lake ice extending about 5 to 10 miles from the shore. Some of the shallow bays will have consolidated thick lake ice. The remainder of the lake will be open water near the shore to ice free towards the central part of Lake Huron and south-western Georgian Bay. The expected ice cover for January 1st is illustrated in Figure 4.

The seasonal outlook for January and February will be generally below normal temperatures over the entire area. With below normal temperatures, ice growth and expansion will be somewhat greater than normal. The ice will along shore in the south-eastern and western section of the lake will continue to thicken. Consolidated ice will take hold in the eastern and western section of the North Channel as well as the north-eastern shore of Georgian Bay during the first week of January. The central portion of the North Channel will be covered with thin and medium lake ice. The approaches to the Straits of Mackinaw will have thin and medium lake ice. By mid-month, almost all of the North Channel will be consolidated with medium and thick lake ice while Saginaw Bay will have consolidated thin and medium lake ice. The coastal area of the remainder of the lake will have varying concentrations of thin and medium lake ice with some thick lake ice near the approaches to the Straits of Mackinaw. Thin

and medium lake ice will cover the northern half of Georgian Bay. By the end of January, all of the North Channel will be consolidated with medium and thick lake ice while Saginaw Bay will have mostly consolidated medium lake ice. The approaches to the Straits of Mackinaw will also be consolidated. The ice extent along the Lake Huron shore will be about 8 to 15 miles with most of the southern and north-western portion of the lake being completely frozen over. Most of Georgian Bay will be covered with thin and medium lake ice with only the south-western portion of the bay having some open water. The central portion of the lake will be open water to ice free. The expected ice cover for February 1st is illustrated in Figure 6.

During the first half of February, The eastern shore of the lake will develop a narrow band of consolidated ice. The north-western portion of the lake east of the entrance to the Straits of Mackinaw will be covered with thin and medium lake ice with consolidated medium and thick lake ice near the entrance to the straits. Elsewhere over the middle third of the lake, ice will continue to expand so that by the middle of the month only the central portion of the lake will remain open water. Most of Georgian Bay will be covered with medium and thick lake ice with some areas of new and thin lake ice in the south-western portion of the bay. By the end of February, little change will occur with the ice extent however some of the ice will have thickened to thick lake ice especially along the eastern shore of the lake from Point Clark southward and in the central part of Georgian Bay. The expected ice cover for March 1st is illustrated in Figure 8.

With generally below normal temperatures during the winter season, clearing of Lake Huron will occur later than normal.

Lake Erie and Lake St Clair

Water temperatures ranged from 0.6°C in the Western Basin to 1.2°C in the east. Air temperatures will average near normal over the entire lake during the month of December.

At the beginning of December, generally open water to ice free conditions will dominate over Lake St Clair and Lake Erie. By the middle of December, some new lake ice will begin to form in the south-eastern portion of Lake St Clair with some patches of new lake ice in the Western Basin. Elsewhere, mainly open water to ice free conditions will persist. The coastal area of the Western Basin will have some new lake ice during the third week of December and expand to cover the entire basin by the end of third week. All of Lake St Clair will be completely covered with thin and new lake ice at the same time. By the end of the month the remainder of Lake Erie will be open water with some isolated patches of new lake ice along the shore. The expected ice cover for January 1st is illustrated in Figure 4.

The forecast temperatures over Lake Erie will be near to below normal for January and February. Consequently, ice growth and thickness will be near to thicker than normal. Ice will expand outside of the Western Basin and along the shores. By mid-January, narrow bands of thin and new lake ice will stretch along the southern and northern shore to the Buffalo area. The east-central portion of the lake will remain open water with a few patches of new lake ice drifting into the area. Lake St Clair will have thin and medium lake ice. During the third week of January all of Lake Erie will be frozen over with medium and thin

lake ice. Lake St Clair and the Western Basin will be consolidated with medium and thick lake ice. The expected ice cover for February 1st is illustrated in Figure 6.

During the first half of February, the ice in Lake Erie will thicken to thick lake ice with some areas of thinner ice due to frequent storms causing leads. The thickest ice will be located in the eastern and southern portions of the lake as well as the Western Basin. Lake St Clair will remain consolidated with thick lake ice. By the end of February, little change in ice extent will occur. Most of the ice will have reached the thick lake ice stage except for the area along the northern shore which could have some areas of thin and new lake ice. The expected ice cover for March 1st is illustrated in Figure 8.

With generally near to below normal temperatures over the winter season and near normal temperatures in the spring, ice melt will be somewhat slower than normal during the spring.

Lake Ontario

Water temperatures varied from near normal over the eastern and central portion of the lake to 0.9°C in the western section. Temperatures over Lake Ontario during the month of December will be generally below normal.

At the beginning of December, ice free conditions prevailed over the entire area. By the middle of December some new and thin lake ice will form in the Bay of Quinte. By the end of December, new and thin lake ice will begin to form in the entrance to the St Lawrence River as well as along the eastern shore of Lake Ontario. The ice in the Bay of Quinte will thicken to thin and medium lake ice. Some patches of new lake ice will begin to form around the Prince Edward county shore. The expected ice cover for January 1st is illustrated in Figure 4.

The temperature forecast for January and February will be generally below normal. As a consequence, ice growth and thickness will be greater than normal especially in the eastern section of the lake. During the first week of January ice will spread south-westward from the St Lawrence River to about 3 to 8 miles from the shore. The lake ice will mostly be thin and new. New lake ice will continue to form in the bays along the Prince Edward county shore. By mid-January some narrow bands of new lake ice will form along the northern and southern shore. At the same time, the entire north-eastern section of the lake will be covered with thin and new lake ice. The entrance to the St Lawrence River will be consolidated with thin and medium lake ice. The rest of the lake will remain ice free with open water conditions prevailing within 3 to 6 miles of the shore or ice edge. By the end of January, the ice edge in the north-eastern part of the lake will extend 10 to 25 miles from the shore while elsewhere the ice edge will be 2 to 5 miles from the shore. Ice thicknesses will vary from medium and thin in the eastern section and around Prince Edward County to new and thin elsewhere along the shore. The central portion of the lake will be ice free with open water conditions within 2 to 5 miles of the ice edge and shore. The expected ice cover for February 1st is illustrated in Figure 6.

During the first half of February, the ice extent will continue to expand from the eastern portion of the lake. By mid-month the eastern third of the lake will be almost completely covered with thin and medium lake ice. Elsewhere along the coast, a band of 2 to 5 miles of thin and

new lake will persist. The west-central portion of the lake will remain ice free with open water within 2 to 5 miles of the shore or ice edge. By the end of February, the ice edge will retreat somewhat north-eastward while the narrow bands of thin and new ice along the coast will begin to melt back somewhat. Ice thickness will be mostly medium and thick lake ice in the north-eastern portion of the lake. The expected ice cover for March 1st is illustrated in Figure 8.

With generally below normal temperatures during the winter season, ice melt will be somewhat slower than normal during the spring.

Appendix

Appendix A - Stages of Development of Lake Ice.

For more information on this section, please refer to the following web link on the Canadian Ice Service web site:

<http://ice-glaces.ec.gc.ca/App/WsvPageDsp.cfm?ID=11040&LnId=78&Lang=eng>

Appendix B - General information from the Canadian Coast Guard.

General information regarding transmission times for bulletins and charts from various radio broadcast stations:

http://www.ccg-gcc.gc.ca/mcts-sctm/docs/ramn_arm/Atl/dls/part5_e.pdf

Appendix C - WMO (World Meteorological Organization) Colour Code

Information regarding the ice chart colour code using the WMO standard.

<http://ice-glaces.ec.gc.ca/App/WsvPageDsp.cfm?ID=11500&LnId=19&Lang=eng>

Appendix D - Ice Services for Canadian Great Lakes Waters

In Canada, ice services are provided to shipping, fishing and in-lake operators by a co-operative effort of Environment Canada and the Department of Fisheries and Oceans. Department of Fisheries and Oceans, through the Canadian Coast Guard, provides icebreaker services and operates a seasonal Ice Operations Office at Sarnia. Canadian Ice Service of the Atmospheric Environment Service (division of Environment Canada) is responsible for gathering and generating ice information services and forecasts.

The following forecasts are issued:

Great Lakes Ice Hazard Bulletin (FICN19): A general ice description of conditions in each of the Great Lakes and, if required, a warning of hazardous ice conditions for the next 36 hours.

Twice-a-week Ice Analysis Charts and Regional Ice Chart covering a larger area are issued by the North American Ice Service. The Great Lakes Ice Analysis Charts are issued in two sections: the western portion of the Great Lakes which includes Lake Superior and Lake Michigan and the eastern portion of the Great Lakes which includes Lake Huron, Lake St Clair, Lake Erie and Lake Ontario. In addition to the distribution outlined in Appendix B, ice forecasts and bulletins and the Seasonal Outlook are available from the Canadian Ice Service website (<http://ice-glaces.ec.gc.ca>) and the National Ice Center website <http://www.natice.noaa.gov/products/gl-ches/index.htm>. The seasonal outlook is issued once yearly then updated twice monthly by 30-day forecasts.

For further information concerning these services please contact
Canadian Ice Service by phone (613) 996-1550, facsimile (613) 947-9160 or e-mail at:
cis-scq.client@ec.gc.ca.

or

National Ice Center by phone (301) 394-3100, facsimile (301) 394-3200 or e-mail at:
liaison@natice.noaa.gov